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A FINAL REPORT ON PROJECT F 15-R

A FEDERAL AID TO FISHERIES PROJECT

CLEARWATER RIVER FISHERIES INVESTIGATION

II. TROUT MIGRATION STUDIES

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SUMMARY

Downstream migration studies were conducted in 1954, 1955 and 1956 to determine the size and time of juvenile steelhead trout migrations from the tributaries of the Clearwater river drainage.

The success of this study was contingent on the development of suitable trapping gear, gear which could operate at all stages of river flow and during periods when ice and debris were present in the water. Since suitable traps were not developed, operations were limited to the summer and fall months when stream flows were low.

An exploratory enumeration study was conducted in Orogrande creek in 1954. An estimated total of 28,600 small rainbow trout moved downstream out of Orogrande creek during the period July 29 to November 30. Enumeration portions of the studies were discontinued because of lack of suitable gear, the unavailability of experienced personnel and because of the severe ice, debris and river flow conditions which prevented trapping operations during the winter and spring months.

Downstream movements of small rainbow trout were indicated by trap catches during the summer and fall months. These movements occurred during periods of inclement weather, generally marked with rain, falling temperatures or both. Other game fish and rough fish species also moved out of the smaller tributaries during the fall months.

The length-frequency distribution of rainbow trout captured at each trap varied. V- and floating traps appear to be selective to smaller fish as they depend on water velocities to contain fish trapped. The size of rainbow trout captured also varied by month in samples from non-selective spill traps.

Only one rainbow trout over 10 inches In length was included an the 3,491 fish sampled. Less than three per cent of those rainbow captured and measured in non-selective traps were over eight inches in length.

Of 176 cutthroat trout measured, seven were over eight inches in length. Five of these were over 10 inches long, the largest being 15 inches in length.

Seventeen of 28 Dolly Varden trout measured were over eight inches in length. Twelve of these exceeded 10 inches, with the largest measuring 18 inches in length.

A total of 150 whitefish was measured. Ninety-two of these exceeded eight inches in length and 47 were over 10 inches long. The largest whitefish measured 14 inches in length.

The game fish measured indicate that growing conditions in the Clearwater river drainage are adequate to support resident populations of normal-sized game fish. The small size of the rainbow trout indicates a population of steelhead origin.

INTRODUCTION

Trout migration studies were initiated in streams of the Clearwater river drainage which are accessible to anadromous fishes to ascertain the abundance of juvenile steelhead trout, Salmo g. gairdneri, and to estimate the time of their downstream migrations.

There were three major objectives of the study as originally planned. First, it was necessary that suitable downstream traps be developed to sample fish populations moving in all types and sizes of tributaries, under all types of weather and river conditions. Second, if suitable trapping gear and techniques were developed, it was planned to enumerate populations of juvenile steelhead trout migrating out of tributary streams by mark-and-recovery experiments. And, finally, it was planned that the time of peak movements of these young steelhead would be determined from the information gathered at the enumeration study trapping sites and from supplemental trapping sites.

If the size and times of juvenile steelhead movements within the drainage could be noted, it would add to the limited knowledge now available and make more clear the role that these fish play in the sport catch of the drainage. Information concerning migrational periods and the numbers of fish expected to move downstream past possible dam sites is needed to help develop plans for the proper management of this species of fish.

History of the Study

The interpretation of the downstream trapping data and its value were dependent, to a great degree, on the development of a method to separate small rainbow trout captured into the races which could possibly be present.

No method of separating juvenile steelhead from small resident rainbow, Salmo g. irideus, trout was developed. It was assumed by biologists working on the project that a very small population of resident rainbow trout was present in the study areas. Observations during the creel census on size and sexual maturity of rainbow trout lent credence to this assumption.

Trapping operations for downstream migrants were initiated during the summer of 1954 in the North Fork of the Clearwater river drainage near the Bungalow ranger station.

Four basic designs of traps were operated experimentally to determine their effectiveness when fished in tributaries of different size and physical characteristics.

The effects of water fluctuations, debris, and ice conditions were noted as part of the study to determine if traps could be operated during all seasons of the year.

Orogrande creek was selected for initial enumeration studies since it was known to support runs of adult steelhead trout and was readily accessible

by road at several points along the stream. Traps were installed at the mouth and at points three and seven miles above the mouth. Only those fish moving downstream during the fall months were enumerated.

Traps were also installed in the North Fork proper and in Weitas creek and Fourth-of-July creek to determine the effectiveness of the gear used.

With the advent of winter the traps became inoperative due to ice floe conditions. Operations were suspended in this area until the spring of 1955.

A V-trap was operated experimentally in the Clearwater river near Spalding, Idaho in December of 1954 to determine the movements of fish in the river and to observe if it might be feasible to operate traps in this area.

A spill trap was installed in the south ladder of the Lewiston dam located four miles above the confluence of the Clearwater and Snake rivers. This trap fished from January until March, 1955, when it was removed to allow for the passage of adult steelhead up the ladder.

A V-trap was fished in the North Fork of the Clearwater river above the Bungalow ranger station from March until May, 1955, to observe the effects of spring run-off conditions on this type of trap.

It became apparent during the winter of 1954 and 1955 that adverse weather and water conditions would present serious obstacles to year-around trapping. Trapping during the entire year would be necessary to give a complete picture of the migrational patterns exhibited by Clearwater river steelhead trout migrants.

Traps were re-installed in the North Fork drainage during the summer of 1955 after the annual spring run-off. Operations were located near the Bungalow ranger station in order to utilize creel census personnel to check and maintain downstream traps.

Limited trap catch information was obtained in 1955 because insufficient personnel made daily checking of each trap impossible. During September when the peak movement of rainbow trout occurred, student workers had resumed their studies and dependable replacements were not available.

No attempt was made to enumerate downstream movements during 1955. Data pertaining to downstream movements were limited to comparisons with the 1954 data.

It became apparent during the fall of 1955 that V-traps were not adaptable for use in the larger streams of the drainage. Extreme water fluctuations in these streams caused damage and destruction to these trap.

A floating trap was fished experimentally in November of 1955 to determine if it might be used during periods of fluctuating water flows.

Trapping operations were moved to the Middle Fork of the Clearwater river drainage in 1956. Creel census studies were being conducted in this drainage and it was necessary to utilize creel census personnel to check the traps.

Enumeration studies were not continued in 1956 since the experiments in 1954 and 1955 indicated that to enlarge on this phase of the study would involve the use of extensive trapping facilities, a large labor force and the extension of the project past the scheduled completion date.

Trapping studies conducted during 1956 provided supplemental information pertaining to downstream movements of juvenile steelhead trout obtained in 1954-5. Several floating traps were constructed and tested in large streams to determine if they could be utilized in future enumeration studies if the need arose to extend this segment of the project.

Floating traps were fished during the spring run-off of 1956 in the Middle Fork of the Clearwater river near the town of Kooskia. It was determined that these traps could only be fished during freshets with extreme difficulty and operations were discontinued until water flows receded.

Trapping sites were located in the lower ends of the Lochsa and Selway rivers during the summer and fall months. Several traps were also fished in the vicinity of the Powell ranger station in the headwaters of the Lochsa river. Spill traps were installed in tributaries of the lower and upper Lochsa river to obtain data for comparison with that collected in tributaries of the upper North Fork of the Clearwater river drainage.

Two spill traps were constructed and operated intermittently at the Lewiston dam from December, 1955 to August, 1957. These traps did not operate efficiently during extremely cold weather conditions or when large amounts of debris were present in the water.

Definition

For the purpose of this report the term "migration" is used only to refer to seaward migrations of juvenile steelhead trout. All other movements are referred to as such.

TRAPPING GEAR

Five basic types of downstream migrant traps were constructed and operated in streams of the Clearwater river drainage during the study.

The size of the traps was varied to obtain optimum fishing efficiency consistent with the size, gradient, velocity and fluctuation of each stream.

A weir consisting of eight panels approximately 12 feet by 3 feet, constructed of 2 X 4 framework and lined with 1/4-inch mesh hardware cloth was installed in Orogrande creek in 1954. The weir was held in place with rock-filled tripods placed on the downstream side, Figure l. The tripods were wired to large rocks and trees for additional support. Two openings were left in the weir in which upstream and downstream traps were installed. The downstream trap consisted of a flume leading to a screened collection chamber, Figure 2. The upstream trap was made of the same type screened-box with a two-inch V-shaped entrance.

The weir was designed to give a complete count of all fish passing the weir. Extreme water fluctuations and large amounts of logging debris prevented the weir trap from functioning properly on Orogrande creek. Debris collecting on the screen resulted in excessive water pressure which caused undermining of the weir.

Less trouble was encountered when the weir was moved to Johnny creek. The absence of debris resulted in more optimum conditions for operation. The major change in construction at the new location was the use of a downed-tree for support, replacing the tripods, Figure 3.

Overflow-spill traps were operated in small tributaries. A gradient that would produce one-foot of water over the spill was necessary for optimum efficiency. Each trap was constructed to fit the conditions found in the stream. The basic design was identical to the downstream trap of the weir, Figures 4 and 5. Rock wings, screens, and natural channels were used to guide fish into a flume, Figure 6, or directly into the trap. These traps appeared to be non-selective to size of fish. Escape was impossible unless the collection chamber was plugged with debris.

Spill traps did not strain all the water flowing in the tributary streams where they were operated. The proportion of the stream sampled varied with the seasonal variation of flow in the stream. Spill traps were more efficient than other types of traps used because of their lack of size selectivity at all stream velocities.

Extreme water turbulence and velocities in the collection chambers of the spill traps caused the death of some of the trapped fish. This condition was corrected by the construction of baffle-plates in the chamber which provided a resting place for the fish.

V-traps were placed in streams with moderate gradient where water fluctuations prevented the use of weirs or spill traps. Panels, similar to those used on the weir, were set upstream at a 45-degree angle to guide

migrants into a screened live-box with a two-inch opening set in a V-throat entrance, Figures 7 and 8. Wires were attached to rocks, trees, or iron stakes to assist in supporting the structure.

Considerable difficulty was encountered in holding the screens in place. The screen panels filled with ice and debris causing excessive water pressures which ultimately destroyed the trap.

The probability exists that large fish were able to avoid or escape the trap when water velocities dropped below three to four feet per second. Length frequency data tend to verify this assumption.

Kray-Meekin floating traps, developed by personnel of the Washington State Department of Fisheries and modified for this study, were used experimentally in large streams in 1956 to sample populations moving downstream where spill or V-traps could not be fished because of moderate stream gradients or extreme water fluctuations.

These floating traps are seven feet long, three feet wide and two feet deep, constructed of aluminum tubing and covered with a hardware cloth, Figure 9. Water passes through the open upstream end, over and through an inclined screen. Water not passing through this screen drops into a collection chamber or live-box. Fish are retained in the trap by the high water velocity passing the inclined screen and by a screen baffle over the live-box. Float tanks, attached to each side of the trap, provide the necessary buoyancy and 1 x 12-inch boards give the desired planing action to the trap. Cables attached to trees, rocks, or bridge supports hold the traps in place.

The principal advantage of this trap is its floating action which allows for continual operation in one location during fluctuations of water level. The light-weight construction and small size provides a portable trap which can be carried in a pick-up truck and maintained by a small crew.

The disadvantages of the floating trap tend to offset the advantages. The cross-sectional area of the stream sampled is small, from three to six square feet, and consequently, in large streams, the catch is small in comparison to the population moving past the trap. During periods of high water the traps quickly filled with debris and became submerged, sometimes within a matter of minutes after being cleaned. During periods of low water the traps became stranded on the rocks which required rock wings to increase the water flow through the trap or a move to another fishing site. Moving or modifying the traps tend to introduce additional variables which might affect the accuracy of quantitative estimates of fish movements.

The traps tend to be selective to size of fish and this selectivity is in direct relation to water velocity. The lower the velocity the smaller the fish caught. Length frequency data indicate the occurrence of size selectivity. Large fish, above 100 mm. in length, are more abundant in spill traps operated in tributaries of the Lochsa river than in floating traps in the same drainage. Floating traps fished at the mouths of the Selway and Lochsa rivers showed less selectivity for size than the Papoose or Squaw creek traps. Water velocities ranged between three and seven feet per second at the mouth of the Selway and Lochsa rivers while the Papoose

and Squaw creek traps were fishing in velocities of about three feet per second or less. The degree of selectivity for size between various floating traps was not measure.

Fyke nets which were constructed of 3/4- x 3/4- x 1/8-inch angle iron and covered with 1/4-inch mesh hardware cloth were used on a limited basis in 1954. These traps were six feet long and three feet square with a six-inch opening in the fyke. Six- by three-foot screened wings were attached at each side to increase the amount of water sampled. The traps were cumbersome and difficult to repair in the field and were abandoned as unsuitable for use in the streams in the study area.

Severe weather and water conditions prevented the continual use of all types of traps during the months of November through June.

Ice filled and plugged the traps during the late fall, winter and spring. Ice and debris caused the V-traps to wash out, the floating traps to sink, and spill traps to overflow. Figures 11-16 illustrate the conditions which precluded the successful operation of the downstream migrant traps during these periods.

Downstream traps used at the Lewiston dam were similar to the overflow-spill traps used in the tributary streams of the Clearwater river. The trap shown in Figure 10 was installed on the face of the dam. The board shown was used to shut off the water flow. The center rope shown supports a baffle-board which protects fish swept into the screened-collection box.

Figure 1. Downstream migrant weir trap, Orogrande creek, Clearwater river, Idaho, 1954.

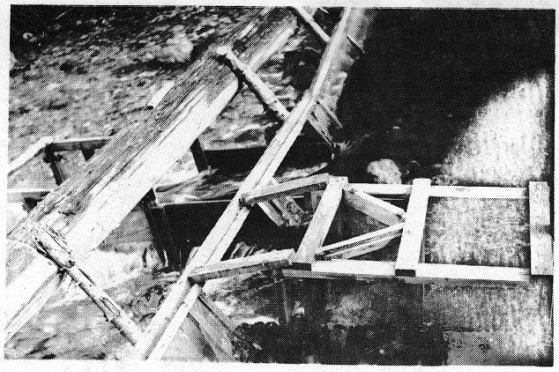


Figure 2. Downstream trap (left) and upstream trap (right) of weir trap, Johnny creek, Clearwater river, Idaho, 1954.

Figure 3. Weir trap installed in Johnny creek, showing use of downed tree for support, Clearwater river, Idaho, 1954.

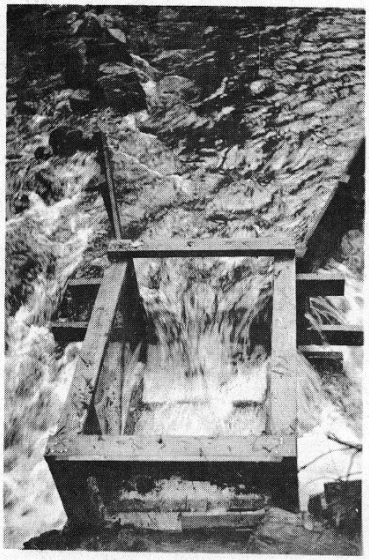


Figure 4. Overflow-spill trap, showing screened box and use of board and rock deflector wings, Orogrande creek, Clearwater river, Idaho, 1954.

Figure 5. Overflow-spill trap, side view, Orogrande creek, Clearwater river, Idaho, 1954.

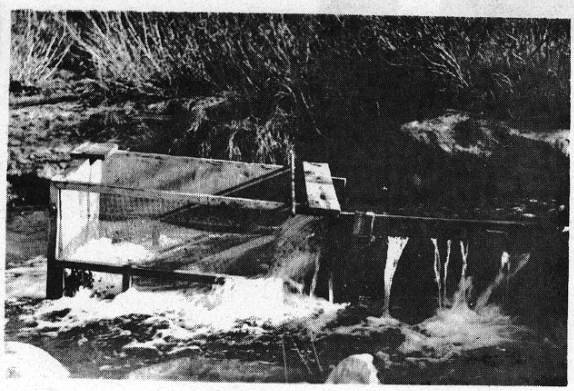


Figure 6. Overflow-spill trap, showing use of flume to produce one foot of head into trap, Orogrande creek, Clearwater river, Idaho, 1954.

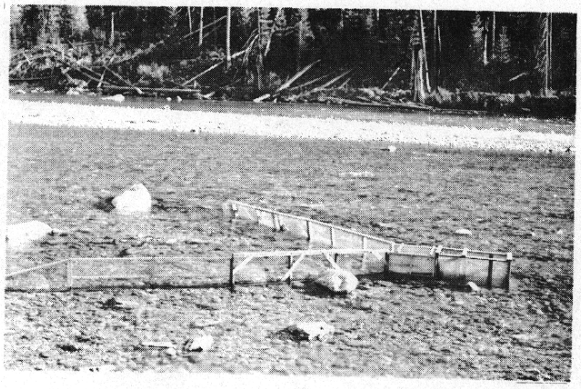


Figure 7. V-trap, showing use of wire panel wings and typical construction of trap, North Fork of the Clearwater river, Idaho, 1954.

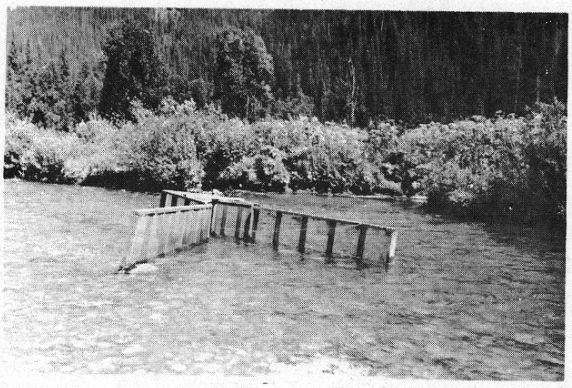


Figure 8. Downstream view of V-trap used in Orogrande creek, Clearwater river, Idaho, 1955.

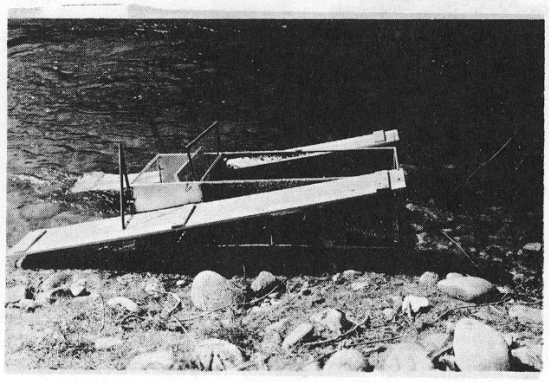


Figure 9. Side view of floating trap, collection chamber (left), upstream opening (right), planing boards attached to sides, Middle Fork of the Clearwater river, Idaho, 1956.

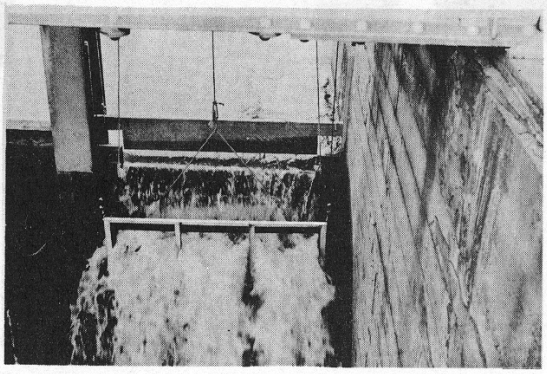


Figure 10. Overflow-spill trap installed at Lewiston dam, Clearwater river, Idaho, 1956.

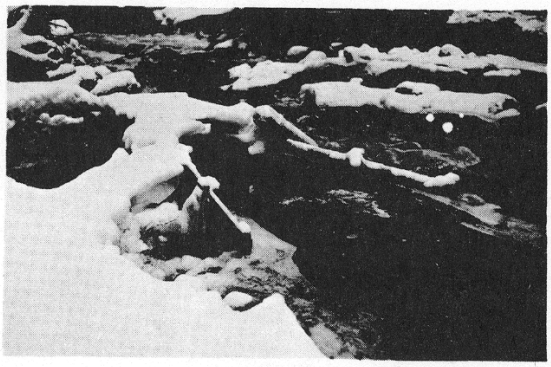


Figure 11. Overflow-spill trap, plugged with ice, Orogrande creek, Clearwater river, Idaho, November 1954.

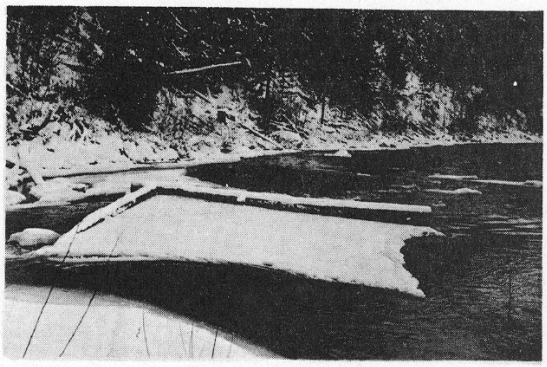


Figure 12. V-trap showing ice-floe conditions in North Fork of the Clearwater river, Idaho, winter, 1954-5.

Figure 13. V-traps at Fawn creek site, North Fork of the Clearwater river, Idaho, early spring, 1955.

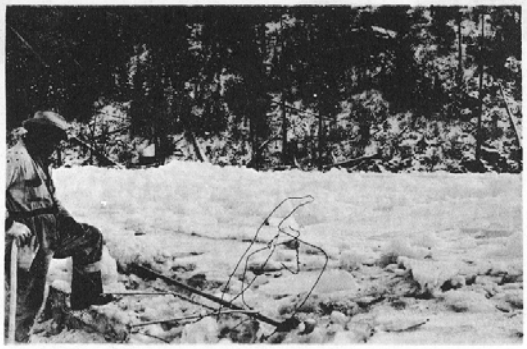


Figure 14. Floating trap near Bungalow ranger station, North Fork of the Clearwater river, Idaho, November 1955.

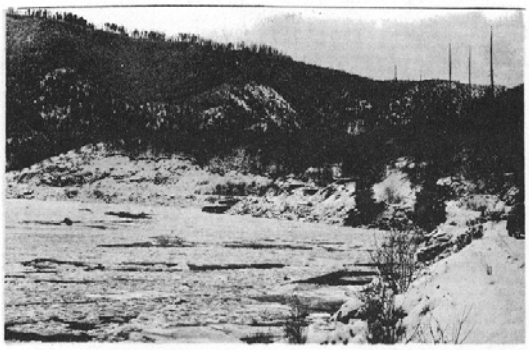


Figure 15. Ice-floe conditions prevail in all drainages in early spring, North Fork of the Clearwater river, Idaho, spring, 1955.

Figure 16. High water and debris prevented successful trapping during spring run-off in the Clearwater river drainage, North Fork of the Clearwater river, Idaho, spring, 1955.

ENUMERATION STUDIES

Studies were conducted in 1954 and 1955 to determine the feasibility of estimating the size of downstream migrations of juvenile steelhead trout from the Clearwater river drainage.

The attempts to enumerate downstream migrations were not successful. The factors contributing to this failure have been pointed out.

A mark-and-recovery experiment was conducted in Orogrande creek, a tributary of the North Fork of the Clearwater river, to determine the population of downstream migrants moving into the North Fork during the period July 29 to November 30, 1954.

Two traps, located three (the Campground spill-trap) and seven (the Seven-mile weir-trap) miles upstream from the mouth of the creek, were operated as one marking battery. A total of 1,166 rainbow trout were captured, marked with an adipose clip, and released from these upper traps.

The bungalow spill-trap, located at the mouth of Orogrande creek, functioned as a recapture battery. A total of 540 rainbow trout was captured during the period July 29 to November 30. Of these, 22 rainbow trout had been marked and released alive from the upstream marking battery. When the ratio of 24.54 unmarked to one marked fish was applied to the total release (1,166) of the upstream traps a total downstream drift of 28,600 rainbow trout was estimated to have moved past the upstream traps. Applying Chapman's (1948, page 16) table, upper and lower limits of this estimate are calculated as 43,282 and l7,688, respectively, at the 95 per cent confidence interval (Murphy, 1955).

The same type enumeration study was attempted in 1955 in Orogrande creek. It was hoped that traps could be installed earlier in the summer but high water prevented the installation of both batteries until August 11.

During the period of greatest fall movement, September 10 to October 3, traps could not be checked regularly because of a lack of available workers. Traps were often damaged or plugged up when they were checked and a large number of the fish died as the result of a long exposure to turbulent fast water

No attempt was made to estimate the populations of rainbow trout because of the limited amount of data collected in 1955.

No attempt was made to extend the enumeration study to other waters in the drainage.

TIMING STUDIES

Studies to estimate the months of peak migration of juvenile steelhead trout were also limited by the weather, river conditions and the other factors mentioned above.

Downstream traps functioned successfully only during the months of July through October. Small numbers of rainbow trout were captured during the months of March through June and November; however, the traps were not functioning correctly due to debris and ice conditions. Captures during these months only indicate that some downstream movement was occurring.

A list of downstream traps operated from 1954 to 1956 is shown in Tables 1, 2, and 3. Figure 17 shows the location of the streams in which these traps were operated.

Rainbow trout were the predominant game fish captured in the North and Middle Fork of the Clearwater river drainages. Whitefish, Prosopium williamsoni, cutthroat trout, Salmo clarki lewisi, and Dolly Varden trout, Salvelinus malma, were also captured but in limited numbers.

Dace, Rhinichthys sp., were the most common rough fish captured. Sculpin, Cottus sp., redside shiners, Richardsonius b. balteatus, squaw-fish, Ptychocheilus oregonensis, and suckers, Catostomus sp., also entered the catch.

Pacific lamprey ammocoetes, Entosphenus tridentatus, were common in the catches of traps located in the North Fork drainage and rare in the catches of the Middle Fork drainage.

Rainbow trout movements

Peak downstream movements of rainbow trout from tributary streams of the Clearwater river were recorded by trap captures during the late summer and fall months. These movements do not coincide with the seaward migrations of juvenile steelhead from other tributaries of the Columbia river where year-around trapping operations were conducted.

Mains and Smith (1955) reported that only one seaward migration of juvenile steelhead occurred in the Snake river, and this during the spring months. Their downstream traps were located approximately 50 miles below the confluence of the Clearwater and Snake rivers. Peak migrations were noticed during mid-May in 1954 and 1955. Studies in the middle Snake river area conducted in 1957-8 indicate dispersal of steelhead trout and chinook salmon prior to their seaward migration.

Traps installed in the Tucannon river, which enters the Snake river 99 miles below the Clearwater, captured migrant rainbows during all seasons. The larger peak migration was noticed in May while a small movement was noticed in November, Mains and Smith (ibid.). Powder river and Eagle creek marking studies also indicate this same type of movement.

Table 1. A list of downstream traps operated during 1954, in the North Fork of the Clearwater river and tributaries, in the vicinity of the Bungalow ranger station.

Trap name	Stream	Trap location	Dates operated	Type of trap	Numbers of fish captured, by species*					
					Rainbow trout	Cutthroat trout	Dolly Varden	White-fish	Dace	Sculpin
Seven-mile	Orogrande creek	7 miles above mouth	7/ 6-8/20	weir w/spill	163	8	0	12	**	--
Camp-ground	Orogrande	3 miles above mouth	8/27-11/30	overflow spill	1064	11	0	8	--	--
Bung-alow	Orogrande	at mouth	7/29-11/30	overflow spill	540	20	4	69	136	2
None	North Fork	mouth of Fawn creek	10/ 7-11/30	V	49	0	2	8	2	--
None	Johnny creek	at mouth	8/27-10/31	weir w/spill	55	5	3	0	38	1

*No mention was made of lamprey ammocoetes; however, a narrative report indicates that several hundred were captured at the Seven-mile weir.
**Counts of non-game fish are incomplete.

Table 2. A list of downstream traps operated during 1955, in the North Fork of the Clearwater river and tributaries, in the vicinity of the Bungalow ranger station.

Trap name	Stream	Trap location	Dates operated	Type of trap	Numbers of fish captured, by species						
					Rain-bow trout	Cut throat trout	Dolly Varden	White-fish	Dace	Sculpin	Lamprey ammocoetes
Camp-ground	Orogrande	3miles above mouth	6/16-7/8	overflow spill	42	0	0	0	--**	--	14
Hard Luck	Orogrande	2 miles above mouth	7/ 9-10/12	overflow spill	96	1	0	0	--	--	226
Bung-alow	Orogrande	at mouth	8/11-11/ 9	overflow spill	649	6	11	81	59	3	99
Bear trap	Orogrande	6 miles above mouth	6/11-10/12	V	58	0	0	0	122	2	182
Del Cox	North Fork	Bungalow ranger station	8/ 6-11/11	V	81	0	0	4	11	5	67
Pete Ott	North Fork	mouth Pete Ott creek	7/16-10/10	V	38	0	1	0	12	1	143
Weitas camp	Weitas Creek	at mouth	7/16-10/25	V	31	0	0	0	15	2	11
--	Weitas Creek	3 miles above mouth	7/9-11/11	V	90	0	0	0	--	3	44
--	Kelly creek	1.5 miles above mouth	7/30-10/25	V	31	0	0	1	6	1	9
--	North Fork	At Bungalow ranger station	11/2-11/11	floating	6	0	0	3	--	--	--
--	North Fork	mouth of Fawn creek	3/21-5/ 6	V	54	9	0	0	--	--	--

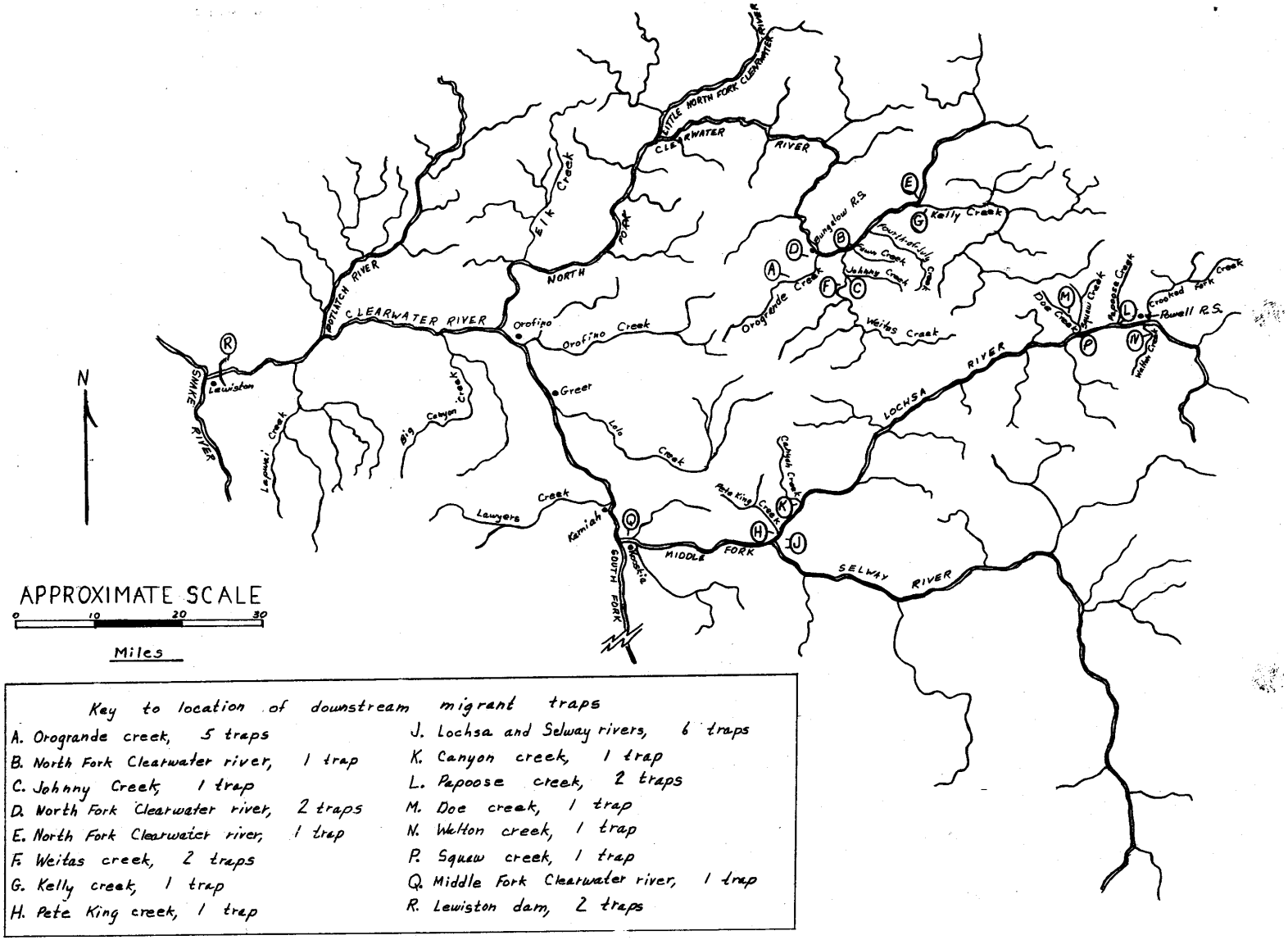
*Records of non-game fish trapped are incomplete

Table 3. A list of downstream traps operated in the Middle Fork of the Clearwater river drainage during 1956, showing species of fish caught and dates fished.

Stream	Trap location	Dates operated	Type trap	Numbers of fish captured, by species									
				Rainbow trout	Cutthroat trout	Dolly Varden trout	Whitefish	Dace	Sculpin	Redside shiner	Squawfish	Sucker	Lamprey ammocoetes
Pete King	mouth	7/ 1-11/19	overflow spill	1130	8	6	1	1820	111	--*	2	16	--
Canyon	mouth	7/21-11/19	overflow spill	100	0	1	0	4	--	--	--	--	--
Papoose	mouth	7/22-10/25	overflow spill	341	89	14	1	114	19	--	--	--	--
Doe	mouth	10/ 6-10/25	overflow spill	45	69	0	0	--	--	--	--	--	--
Walton	mouth	9/ 9-10/25	overflow spill	2	5	2	0	--	--	--	--	--	--
Squaw	mouth	6/ 2-10/16	floating	167	1	1	0	1	--	--	--	--	--
Papoose	mouth	6/ 9-7/24	floating	110	0	1	0	--	--	--	--	--	--
Middle Fork	mouth	3/21-4/22	floating	2	0	3	0	7	11	8	--	--	1
Selway river	Swiftwater bridge	6/17-11/19	3 floating	79	1	8	12	abun.**	abun.	abun.	6	7	1
Lochsa river	mouth	6/ 7-10/19	3 floating	48	2	0	21	abun.	abun.	abun.	1	26	1

*Records of non-game fish are incomplete

**Catches of fish marked abundant were in excess of several hundred fish each; records were incomplete.



CLEARWATER RIVER DRAINAGE - IDAHO

Figure 17. Clearwater river drainage showing streams in which downstream traps were located during the Clearwater fisheries investigation.

A major downstream migration of rainbow was indicated during the months of April and May by trapping operations in the Yakima river, which enters the Columbia near the mouth of the Snake river. Few captures were recorded during the other months of the year, Mains and Smith (ibid.).

Monthly records of downstream migrant rainbow trout captured in the fingerling by-pass traps at Bonneville dam in the lower Columbia river indicate that a major downstream migration occurs from March through June with only minor movements during the other months of the year (Anonymous, 1950).

It is probable that the downstream movements indicated by the traps operated in the Clearwater drainage were seasonal. Rainbow trout and other fish species captured in the traps apparently move out of the smaller tributary streams before the onset of the severe winter conditions which exist in the drainage.

The daily catches of rainbow trout recorded at five traps fished in 1954, 1955, and 1956 are summarized in Table 4.

These traps were selected for comparison because they are spill traps which were less subject to variations due to water fluctuations and fish-size selectivity, they were not moved or modified as were many of the other experimental traps, they captured sufficient rainbow trout to allow for analysis of the migrational peaks, and they were located near weather stations where daily precipitation records were kept.

Those traps fished in 1954 and 1955 were located in Orogrande creek, a tributary of the North Fork of the Clearwater river. All were within seven miles of the Bungalow ranger station where daily precipitation records are kept for the Weather Bureau, U. S. Department of Commerce (Anonymous, 1954 and 1955).

The Pete King creek trap was located six miles from the Fenn ranger station where similar records were kept in 1956.

Downstream rainbow trout movements past all trapping sites appear to be related to the occurrence of rainfall which affected the physical characteristics of the streams. Precipitation during the summer and fall months causes increased stream flow, higher water velocities, cooler water temperatures, and increased water turbidity.

A detailed analysis of which of the factors caused the increased catches of fish during and after the occurrence of precipitation is not attempted. Variances in water temperature records occurred because the traps were checked at different times each day. Weather records were kept by trap operators only for the time at which the traps were checked and did not always reflect the weather conditions which prevailed since the trap was last checked.

Small catches of rainbow trout were recorded at the traps operated during the month of July in 1954 and 1956. The only increases in catch were noted on July 21, 1954 and July 3, 1956 when over .30 of an inch of rain was recorded. Other traps not shown also had comparatively small catches during the month of July.

Table 4. Rainbow trout captures, by day, at downstream traps, and daily precipitation records, Clearwater river, Idaho

July

Date	1955 Ppt. in inches*	1955 Traps Seven-mile	1955 Traps Bungalow	1955 No traps operating	1956 Ppt. in inches*	1956 Trap Pete King
1	.16				.02	6
2	T				.19	8
3					.37	17
4					.01	no record
5	T					6
6					.03	2
7	.14					3
8						3
9	.01					1
10	.02					inoperative
11	T				.13	4
12						4
13					.07	2
14	.06				.02	4
15	.20	installed				5
16	T	1				9
17		9				2
18		4				5
19		5				7
20		8				5
21	.37	41				4
22		7				5
23		0				2
24		2				6
25		2				6
26		2				1
27		0				4
28		1				3
29		1	installed		T	7
30		1	13		.09	4
31		0	9		.16	7
Totals		84	22			142

Table 4. continued. Rainbow trout captures, by day, at downstream traps, and daily precipitation records, Clearwater river, Idaho.

August

	1954				1955		1956	
	Ppt. in	No. Rb trapped			Ppt. in	No. Rb trapped	Ppt. in	No. Rb trapped
Date	inches*	Seven-mile	Campground	Bungalow	inches*	No traps operating	inches*	Pete King
1			--	7				5
2			5	3			T	12
3			0	0			T	28
4			--	4				35
5	T		0	7			T	21
6			4	1				15
7			--	--			.01	2
8			0	11	T			11
9			--	--				3
10			10	4				4
11			--	3				1
12			--	3				6
13			9	2				6
14	.01		--	--				7
15	T		--	3		operating	.06	5
16	.28		52	5		--	.55	3
17	.08		8	4		10		43
18			19	5		14		28
19			13	6		5		14
20	.77		4	1		0		6
21	.15		moved	--		--		3
22	.04			--		0		3
23	.05			0		--		7
24	.34			7		--	.01	4
25	.34			24	T	--	.21	3
26	.46			installed		11	.45	28
27	.05			35		0	.68	262
28				15		--	.03	34
29				5		--	.28	64
30	T			3		12	T	72
31	.24			7		--		47
Totals			124	65	243		52	782

* - indicates trap not checked this day.

Table 4. continued. Rainbow trout captures, by day, at downstream traps, and daily precipitation records, Clearwater river, Idaho

September

	1954			1955		1956	
	Ppt. in	No. Rb trapped		Ppt. in	No. Rb trapped	Ppt. in	No. Rb trapped
Date	inches*	Campground	Bungalow	inches*	No traps operating	inches*	Pete King
1		--	7		19		30
2		5	4		--		13
3		--	--		--		9
4		11	2		--		--
5	.49	--	--		1		--
6		--	--		--		--
7		80	44		--		--
8		22	22		--		--
9		14	4		3		--
10		--	6		--		6
11		18	0		--		2
12		5	2		--	T	2
13		--	--		--		3
14		21	14	0	--		0
15	.13	19	3	1	--		--
16	.04	90	15	0	--		0
17	.72	65	24	0	--		0
18	.43	6	12		inoperative		1
19		90	14		180		2
20		31	--	0	--	T	1
21		19	--		--	.29	0
22		26	18	0	--		17
23	T	24	3		--		13
24		23	4		--		8
25		20	1		98		2
26		14	0		--		2
27		8	2		--	.04	3
28	.09	5	1	0	--	.14	5
29		31	0	0	100	.01	11
30		42	7	0	--	.30	5
Totals		689	209		401		135

Table 4. continued. Rainbow trout captures, by day, at downstream traps, and daily precipitation records, Clearwater river, Idaho

October

Date	1954 Ppt. in inches*	1954 No. Rb trapped Campground	1954 No. Rb trapped Bungalow	1955 Ppt. in inches*	1955 No. Rb trapped No traps operating	1956 Ppt. in inches*	1956 No. Rb trapped Pete King
1		43	4		53		0
2		50	11		--		2
3		43	1		11		4
4		24	0	1	12		--
5		15	2	1	--		--
6		31	--	0	19		--
7		--	--		3		0
8		25	--	0	6		0
9		17	0	0	4		0
10		--	--	1	inoperative	.09	0
11	.59	9	0	0	"	.23	0
12	.27	4	0	0	"	.72	0
13		1	10		"	.20	0
14		12	--		9		0
15		8	--		6		0
16		8	0		1		0
17	.19	4	0		2		0
18		4	7		8	.51	0
19		--	0	0	6	.18	0
20		--	--		8		0
21	.99	--	--	0	--	.21	0
22		--	--		--		0
23		--	--		1	.30	0
24		--	0		2	.12	0
25		0	0		9	.55	2
26		2	0	0	2	.45	0
27		0	--		4	.48	1
28		1	--	T	2	.05	5
29		--	--		3	.01	4
30		--	--		4	.41	--
31		--	1		1	.35	1
Totals		300	36		176		19

Increased catches were noted at most traps in August whenever precipitation occurred. The Bungalow trap in 1954 does not shave increased catches during the period August 16 to August 24. Operational difficulties during this period necessitated repair of the trap and the results are not indicative of the catches which would be expected. This trap was not checked daily during 1955.

Three peak movements of rainbow trout were recorded at the Pete King trap in 1956. Each of these occurred during periods of inclement weather, during or after precipitation.

Apparently the greatest downstream movement of rainbow trout in 1954 and 1955 occurred during the month of September. Captures at the Pete King trap in 1956 were small even though precipitation occurred during the end of the month.

Movement past all traps declined during the month of October in spite of moderate to heavy amounts of precipitation. It is possible that during the preceding months the majority of the population present in the stream had moved downstream or that water temperatures had lowered to a point where the fish would not migrate.

During November traps were operative only on a limited basis. Ice formation on the traps prevented their continual operation. Minor catches were recorded on those days that the traps were functional and from these records it is assumed that no large movements occurred. Eagle creek studies in 1957-8, however, indicate an increased downstream movement whenever ice floes are present in the stream.

Catches of rainbow trout in all other traps operative in 1954 to 1956 appeared to be influenced by the same factors mentioned above.

It is possible that localized showers may have influenced the movements of fish in Orogrande and Pete King creeks without being regarded at the weather gauge stations.

Continued cloudy weather without precipitation may have caused water temperatures to lower and thus caused increased movements of rainbow trout.

Downstream traps in operation at the Lewiston dam near the mouth of the Clearwater river did not catch sufficient numbers of rainbow trout to permit conclusions about migration past this points.

Only 36 rainbow trout were captured in the two traps operating from December, 1955 to October, 1957, Tables 5 and 6. Of these, 16 were captured in a one-week period in March of 1956. The other captures were made throughout the year.

These traps were non-functional periodically due to ice formation during the winter months, excessive debris, and counter attraction of spill during the spring months and forebay water elevation fluctuations during the fall.

It is postulated that the rainbow trout drift out of the smaller tributaries during the fall months and remain in the larger tributaries of the

Table 5. Monthly captures of fish in downstream trap located in the south ladder of the Lewiston dam, December, 1955 to August, 1957, Clearwater river, Idaho.

Month	Species captured and number*											Remarks
	rainbow trout	Troutperch	Chiselmouth	Smallmouth bass	Redside shiner	Squawfish	Bullhead	Sucker	Dace	Lamprey ammocoetes	Sculpin	
1955												
December		200	5	1	6	2		6				
1956												
January	1	200			1	2						
February		5										trap iced up
March	16	900	20		34	4	3		2	1		
April												no records
May	1											
June					3	1		2		1		
July	1		2		9	6	1	16				
August					3			1				
September												water off
October	1	9	1	10	1	1	6	1				
November	2	100		2	14		3	48				
December	1	500	1	1	2		1	4			2	
1957												
January		7					1	3				trap iced up
February		700	1		60	4		35	3	10		
March		1200	1	20	38	7	7	27	16	1	6	
April	1	1200	2	3	11	3	2	4	7		8	
May		900	1		14	12	5	7	1		2	
June		10		1		11	1		1		3	
July		2			4			2			1	
August	1			1	10	8		1			4	

*Also captured were one cutthroat trout, three largemouth bass, one bluegill, and one unidentified, decomposed trout.

Table 6. Monthly captures of fish in downstream trap located in the Lewiston dam spillway on the face of the dam, August, 1956 to October, 1957, Clearwater river, Idaho.

Month	Species captured and number*								Remarks
	Rainbow trout	Troutperch	Chiselmouth	Smallmouth bass	Redside shiner	Squawfish	Bullhead	Sucker	
1956									
August	1			7	5	3	1	3	
September				10			1		water low
October		9		10	3	3	3	1	
November		50			5	1	1	1	
December		50	1		11	1		2	trap iced up
1957									
January		1							trap iced up
February		6			1		1		trap iced up
March		50	4	2	4	5			
April	1	1	2		1	1			
May	1			1	1				
June	1	6							
July	1	150	1	3	2	4	1	8	
August		8			2	6		1	
September		3		6		1			
October				5	2				last entry 10/18/57

*Also captured were 2 dace and 4 lamprey ammocoetes.

Clearwater river during the winter. In the spring those rainbow trout which have developed their migratory instinct leave the river and enter the Snake river during the freshet and continue their migration to the Pacific ocean.

Movements of other species

Downstream movements of other species of fish resident to the streams in which traps were operated were recorded during the late summer and fall months. These are shown in Tables 1, 2, and 3.

Each species exhibits a tendency to drift downstream. The peak movements of some of these are correlated with the downstream movements of rainbow
trout during periods of inclement weather. Tables 7 and 8 illustrate the downstream movements of the more numerous species captured in the Pete King creek and the Papoose creek spill traps.

Captures of game and non-game fish species in other traps indicate the same increases of movement during periods of inclement weather. It is, therefore, assumed that most of the species present in the tributaries of the Clearwater river exhibit a tendency to drift into the larger bodies of water to escape the severe winter conditions or crowding, or both, as found in the drainage from December through February.

Downstream traps operated at the Lewiston dam captured 14 species of fish, Tables 5 and 6. Troutperch, Percopsis transmontana, were the most abundant non-game fish captured. Over 6,000 individuals of this species were recorded with peak captures occurring during the spring months. Small-mouth bass, Micropterus dolumiu, were the most abundant game fish captured. A total of 93 individuals was collected. Peak captures were made both in the fall and spring months.

Other species captured at the Lewiston dam included redside shiners, squawfish, suckers, dace, sculpin, rainbow trout, cutthroat trout, Pacific lamprey ammocoetes, bluegill sunfish, Lepomis macrochirus, largemouth bass, Micropterus salmoides, chiselmouth, Acrocheilus alutaceus, and bullhead catfish, Ameiurus sp.

An examination of the monthly catch records of the traps at the dam indicates increases in catches of all species during the spring months.

Water currents in the forebay during these months are subject to con-siderable variability with regard to the direction and velocity of flow. These currents undoubtedly affect the movement of fish within the forebay and increase or decrease the catch of the downstream traps at the dam.

It is impossible to determine if the downstream movement of individual species is intentional on the part of the fish or if they are simply swept into the current entering the trap.

Table 7. Captures of fish recorded at Pete King creek spill trap, July 1 to September 28, 1956, grouped by five-day periods, Clearwater river, Idaho.

Period	Number of each species captured		
	Rainbow Trout	Dace	Sculpin
7/1-5	37	11	6
7/6-10	9	20	2
7/11-15	19	46	6
7/16-20	28	46	17
7/21-25	23	62	19
7/26-30	19	98	14**
7/31-8/4	87**	139**	12
8/5-9	52	37	5
8/10-14	24	24	1
8/15-19	93**	26	7
8/20-24	23	29	2
8/25-29	391**	164	3
8/30-9/3	171	309**	2
9/4-9	No records, traps inoperative		
9/10-13*	13	168	0
9/14-18	1	189	0
9/19-23	33	231**	2
9/24-28	20	135	2
Totals	1043	1688	94

*Period includes only four days
**Denotes approximate time of peak downstream movements for each species.

Table 8. Captures of fish recorded at Papoose creek spill trap, August 10 to October 3. 1956, grouped by five-day periods, Clearwater river, Idaho.

Period	Number of each species captured				
	Rainbow	Dace	Sculpin	Cutthroat	Dolly Varden
8/10-14	23	7	0	2	3
8/15-19	15	15	0	1	2
8/20-24	14	21	0	1	4**
8/25-29	25	22**	0	2	1
8/30-9/3	50**	20	11**	1	2
9/4-8	41	18	5	0	1
9/9-13	16	5	2	1	0
9/14-18	5	1	0	1	0
9/19-23	13	3	1	2	0
9/24-28	34	0	0	19**	1
9/29-10-3	36**	1	0	16	0
10/4/2008	10	0	0	1	0
10/9/2013	18	0	0	6	0
10/14/2018	14	0	0	25**	0
10/19/2023	5	0	0	6	0
Totals	319	113	19	84	14

**Denotes approximate time of peak downstream movements for each species.

LENGTH FREQUENCY DISTRIBUTION OF GAME FISH CAPTURED

Rainbow trout

The length frequency distribution of rainbow trout captured in the downstream traps is shown in Tables 9, 10, and 11 for 1954, 1955, and 1956, respectively.

Not all rainbow trout captured are represented in the tables. No measurements were made before September 23, 1954 as the traps were being used for enumeration experiments and handling of fish was kept to a minimum. On other occasions fish were not measured.

It is assumed that the samples shown in the tables are representative of the total catch for each trap as bias is not apparent for those fish not measured.

Project leaders in 1955 and 1956 indicated that V-traps and floating traps were selective to size of fish, (Murphy, 1956, and Corning, 1957).

The length frequency data for 1954 and 1955, Tables 9 and 10, support this assumption since, in most cases, the size range of rainbow trout captured in the V-traps is smaller than those taken in the spill traps.

Floating traps also appear to be selective to smaller fish. The Papoose creek and Squaw creek floating traps were fished at water velocities of from one to three feet per second while the six traps fished at the mouths of the Lochsa and Selway rivers sampled water velocities of three to seven feet per second.

The catch of the floating traps fished at the lower velocities was limited to smaller fish while the Lochsa-Selway floating traps captured fish in a size range comparable to the catch of the spill traps fished in 1956.

Success of both V- and floating traps to contain the fish trapped was largely dependent on water velocity. Traps fished at low water velocities captured only the smaller fish.

Other variables besides selectivity of traps to size of fish appear to influence the size distribution of the rainbow trout entering or being captured by all types of traps. Among these are the stream fished, location in the stream, season of year, differential growth and mortality rates and recruitment.

In 1955 the Campground spill trap caught rainbow trout which ranged in size from two to six inches. Of the 42 captured 85.7 per cent were between two and three inches in length. This trap fished from June 16 to July 8.

The Bungalow trap, which was not installed until August 11, captured fish from one to ten inches in length. Ninety-four per cent of these were over three inches long.

Since both of these traps are assumed to be not selective to size of fish, it would appear that greater proportions of the trout moving down or out of

Table 9. Length frequency distribution of rainbow trout captured in downstream traps in North Fork of the Clearwater river drainage, 1954, expressed in per cent by one-inch groups.

Size class in inches	Traps		
	Campground (spill)	Bungalow (spill)	North Fork (V)
0-1	0	0	0
1-2	3.8	0	4.2
2-3	11.5	4.5	56.2
3-4	4.3	4.5	31.2
4-5	42.5	24.4	4.2
5-6	31.2	51.1	4.2
6-7	3.9	11.1	
7-8	1.9	2.2	
8-9	0.7	0	
9-10	0.2	2.2	
n*	584	45	48

*The numbers of fish represented were those measured after September 23, 1954. No measurement records are available prior to this date.

Table 10. Length frequency distribution of rainbow trout captured in downstream traps in North Fork of the Clearwater river drainage, 1955, expressed in per cent by one-inch groups.

Size Class in inches	Spill traps			V traps					
	Bungalow	Hard Luck	Camp-ground	Bear Trap	Weitas creek	Weitas camp	Del Cox	Pete Ott	North Fork (Fawn)
0-1	0	0	0	0	0	19.4	0	0	0
1-2	0.5	1	0	8.6	62.2	71	17.3	23.7	15.7
2-3	3.1	17.7	85.7	55.3	24.5	6.4	21	13.2	49
3-4	5.7	22.9	7.1	17.2	7.8	0	17.3	10.5	11.8
4-5	14.3	21.9	2.4	15.5	4.4	0	22.2	7.9	5.9
5-6	33.7	19.8	4.8	3.4	1.1	3.2	13.6	5.2	3.9
6-7	34.4	13.6	0	0	0	0	6.1	31.6	3.9
7-8	7.2	1	0	0	0	0	2.5	7.9	3.9
8-9	0.9	2.1	0	0	0	0	0	0	3.9
9-10	0.2	0	0	0	0	0	0	0	0
10-11	0	0	0	0	0	0	0	0	2
n	649	96	42	58	90	31	81	38	51

Table 11. Length frequency distribution of rainbow trout captured in downstream traps of the Middle Fork of the Clearwater river drainage, 1956, expressed in per cent by five-mm. groups.

Size class	Spill traps		Floating traps		
in mm.	Pete King	Papoose	Papoose	Squaw	Lochsa, Selway
35-39	0.2	0	0	0	1.2
40-44	6.5	0	0	0	3.5
45-49	18.4	0	2.8	2.5	7
50-54	18.9	4.5	9.5	5	2.4
55-59	12.6	10.5	20	12.9	15.2
60-64	2.7	4.5	20	16.7	7
65-69	1.1	4	18.1	12.3	4.7
70-74	0.4	2	12.5	12.3	2.4
75-79	0.5	2.8	4.8	12.3	1.2
80-84	0.9	2	7.6	11.7	1.2
85-89	2.5	4.2	2.8	10.5	0
90-94	2.7	1.4	1.9	3.8	3.5
95-99	2.8	4.5			7
100-104	4.4	3.4			0
105-109	4.2	4.8			1.2
110-114	5.2	9.3			0
115-119	4.7	11.6			7
120-124	2.6	5.4			2.4
125-129	2.3	3.7			2.4
130-134	2	3.1			2.4
135-139	1.3	3.4			5.8
140-144	1.3	3.4			4.7
145-149	0.5	2			2.4
150-154	0.2	3.1			3.5
155-159	0.2	2			2.4
160-164	0.2	1.1			3.5
165-169	0	0.8			0
170-174	0.1	0.7			0
175-179	0	1.1			1.2
180-184	0	0.7			1.2
185-189	0.1				1.2
190-194	0.2				0
195-199	0				0
200-204	0.1				0
205-209	0				0
210-214	0				1.2
215-219	0				0
220-224	0				0
225-229	0.1				0
230-234	0.1				1.2
n	973	353	105	162	85

Table 12. Size distribution of rainbow trout measured in the Pete King creek spill trap, by months, Clearwater river, Idaho, 1956.

Months	Number of rainbow trout captured				Total
	Under 74 mm in length		Over 74 mm in length		
	Number	Per cent	Number	Per cent	
July	29	21.2	108	78.8	137
August	485	66.7	242	33.3	727
September-November	77	70.6	32	29.4	109
Totals	591	60.7	382	39.3	973*

*Total represents a sample of total number (1124) of rainbow captured in trap.

Orogrande creek before August, 1955 were small rainbow trout, probably of the 0 (zero) age class. These two traps were three miles apart in Orogrande creek.

A tabulation, by months, of the size frequency distribution of rainbow trout captured in the Pete King creek spill trap in 1956 is shown in Table 12. Rainbow trout under 74 mm (median in 50-54 mm group) are assumed to be young-of-the-year fish (0 age class) as a graph of the length frequency distribution shows bi-modal appearance and age growth analysis by scale readings indicates the age of these smaller rainbow to be 0 age class fish. Rainbow trout under 74 mm in length form 21.2 per cent of the captures in July, 66.7 per cent in August, and 70.6 per cent from September through November. These percentages in the catch differ quite radically from those found in 1955 between the Bungalow and Campground traps.

It is of interest to note the small percentage (approximately one to three per cent) of rainbow trout captured which were over 203 mm, eight inches, in length. Only one rainbow trout was over 10 inches in length out of the 3,491 measured in the sample.

When compared to the relatively large lengths of the other game fish measured the rainbow trout population appears to consist of small individuals. Creel census data reported earlier also indicates the lack of large rainbow trout in the populations sampled in the Clearwater river drainage (Keating and Murphy, 1958).

Cutthroat trout, Doll Varden trout and whitefish

Only one cutthroat trout, 10 to 11 inches in length, and 38 whitefish were measured during the latter part of the downstream trapping operations conducted in 1954.

The whitefish sample ranged in size from 2 to 12 inches in length. The average length was eight and one-half inches. Twenty-nine of these are over eight inches in length and 14 are over 10 inches long.

A total of 82 whitefish, 14 cutthroat and 12 Dolly Varden trout was measured during 1955. These represent most of the total catch of game fish.

The whitefish ranged from one to 13 inches in length, and averaged nine inches. Fifty-four of the whitefish were over eight inches in length and 26 of these were over 10 inches long.

Cutthroat trout from one to 15 inches long were captured. The average size of these was six and one-quarter inches. Four were over eight inches in length and two of these over l0 inches.

Four of the 12 Dolly Varden trout captured were over eight inches in length. Two of these were 13 and 18 inches long. The average size of the Dolly Varden trout was seven and one-half inches. The size range was from one to 18 inches.

Two cutthroat trout, two Dolly Varden trout, and 30 whitefish were measured in the floating traps fished at the mouths of the Lochsa and Selway rivers in 1956. The cutthroat trout were 148 mm and 160 mm, approximately six inches, in length. The Dolly Varden trout measured 325 mm and 358 mm and averaged 341 mm, 13.5 inches in length. The size range of the white-fish was from 59 mm to 354 mm, two and one-quarter to 14 inches in length. The average size of these whitefish was 179 mm, seven inches. Nine of these were over eight inches in length; seven were over 10 inches in length.

Eighty-nine cutthroat trout and 14 Dolly Varden trout were measured in the Papoose creek spill trap in 1956. Only one cutthroat trout over eight inches was captured. It was 283 mm (11 inches) in length. The size range of the other 88 cutthroat trout was from 100 to 188 mm, four to seven and one-half inches in length. The average size was 142 mm (five and one-half inches). Dolly Varden trout from 112 to 433 mm (four and one-half to 17 inches) were captured. The average size was 264 mm, 10-1/2 inches. Eleven of those captured were over eight inches in length. Eight of these were over 10 inches long.

Seventy cutthroat trout were measured at the Doe and Walton creeks spill traps. These averaged 138 mm (five and one-half inches in length). One large cutthroat trout 164 mm (10-1/2 inches) was captured. The other cutthroat trout ranged in size from 120 to 184 mm (four and three-quarters to seven and one-quarter inches in length).

The small sample of game fish measured, other than rainbow trout, makes it difficult to determine the size distribution of various species in the streams sampled.

The large proportion of cutthroat and Dolly Varden trout and whitefish over eight inches in length and the number of these over 10 inches in length indicates that the growing conditions present in the tributaries of the Clearwater river will support populations of normal-sized resident game fish.

The relatively small proportion of rainbow trout over eight inches long indicates resident populations of rainbow trout, if present, are small.

RECOMMENDATIONS

1. Traps utilized during this study were not suitable for use during periods of extreme water fluctuations or wheat ice or debris were present in the water. In future studies of this type, traps of semi-permanent design are to be recommended and these should be maintained on a round-the-clock schedule if they are to operate successfully.

2. Enumeration studies should include the collection of fish in sample areas above the trapping sites to determine the size range and age composition. Sampling should be done before and after migration periods so that a more complete picture may be obtained of the age and size distribution of the migrating and remaining populations.

3. Further studies are needed to determine the nature of the downstream movements of rough fish.

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